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Tungsten Mineralization at the Strawberry Mine, Pony, Montana

Robert L. Meyer

"TUNGSTEN MINERALIZATION
AT THE
STRAWBERRY MINE, PONY, MONTANA"

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A thesis submitted to the Geology department in partial fulfillment of requirements for a Bachelor of Science degree in Geological Engineering.

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AT THE

STRAWBERRY MINE, PONY, MONTANA

ABSTRACT

The Strawberry Mine, located four miles west of Pony, Montana, for many years an intermittent producer of gold are, is once again the scene of mining activity due to the discovery of scheelite in 1953.

Fault structures and the scheelite orebody occur entirely within gneisses of the pre-Cambrian Pony series. The metamorphics are cut by quartz monzonite tongues and pegmatites from the late Cretaceous to early Tertiary Tobacco Root intrusive, over a mile to the south.

Tungsten mineralization is confined to a favorable "horizon" adjacent to the hangingwall of the Strawberry structure with replacement grains of scheelite following the local foliation planes of the gneiss.

Deposition of scheelite was earlier in the sequence than that of auriferous pyrite, and both were brought in by hydrothermal solutions from the Tobacco Root intrusive. Mineralization is apparently controlled closely by both structure and petrology.

The presence of both calcite and apatite and their relationship to ore minerals suggests a hydrothermal origin for both, but more careful work is required to establish this definitely.

INTRODUCTION

The Strawberry Mine, for many years a producer of fluctuating amounts of gold, is now the scene of renewed mining activity due to the discovery of tungsten in its workings a little more than a year ago.

This paper is written in partial fulfillment of requirements leading to a Bachelor of Science degree in Geological Engineering at the Montana School of Mines. It is also an effort to establish the genesis of the tungsten mineralization and its relation to the structural features present in the Strawberry Mine area. Although the tungsten is exposed in only a few places in the present mine workings, the attitude of the orebody is such that it suggests relations to existing sulfide veins and faults that have not been proposed heretofore.

In order to more adequately interpret the origin of the tungsten, a complete petrologic and petrographic study is required, far beyond the scope of this paper. The emplacement of the tungsten is related closely to the petrology of the area, which in itself is a complicated problem, involving even the origin of the rock types present.

Just as any undergraduate thesis must necessarily be limited in its scope, this paper, limited by a short and inclement field season confined to weekends alone, will be narrowed to a description of the local geology by surface and underground maps, its relation to general areal geology, and a microscopic study of the ore and prevalent rock types.

<u>Location and History</u>

The Strawberry Mine is located in section 14, T. 2 S., R. 3 W., Madison County, Montana, on the eastern flank of the Tobacco Root Mountains, which rise from an elevation of about 5,600 feet at Pony to 10,600 at the summit of Mount Jefferson, 8 miles southwest. (See Plate I, A and B) The highest peaks of the range lie in an approximate north-south trend. To the west, beyond the Tobacco Root range, are the towns of Twin Bridges and Sheridan in the Jefferson valley. To the south, approximately 25 miles, is the famous restored gold camp of Virginia City. The foothills in which the mine is located extend eastward into the Gallatin and Madison valleys.

The mine is accessible throughout most of the year by a good mountain road which terminates in Pony, about two miles east. Harrison, about eight miles east of Pony, is served by a branch line of the ~~Great Northern~~ Northern Pacific Railroad and is on Montana State Highway #1, a surfaced road which terminates at U. S. 10S at Sappington Junction to the north and continues south through the towns of Norris and Ennis.

According to Emmett J. Clary, long-time resident of Pony and one of the present operators of the Strawberry Mine, original locations of Strawberry claims were made by Lavoisier C. Moreland in 1877. The claims were surveyed and patent granted in 1878. Although early records are not available, estimated gross value of ore produced by 1909 was $150,000, according to a report by J. H. Warner. By 1933, Hart estimated total gross values at $175,000, and in 1936, E. P. Scallon estimated a total of $225,000. These values were entirely from auriferous pyrite ores. Since 1936, intermittent mining by lessees has taken place, but production figures are not available for this later work.

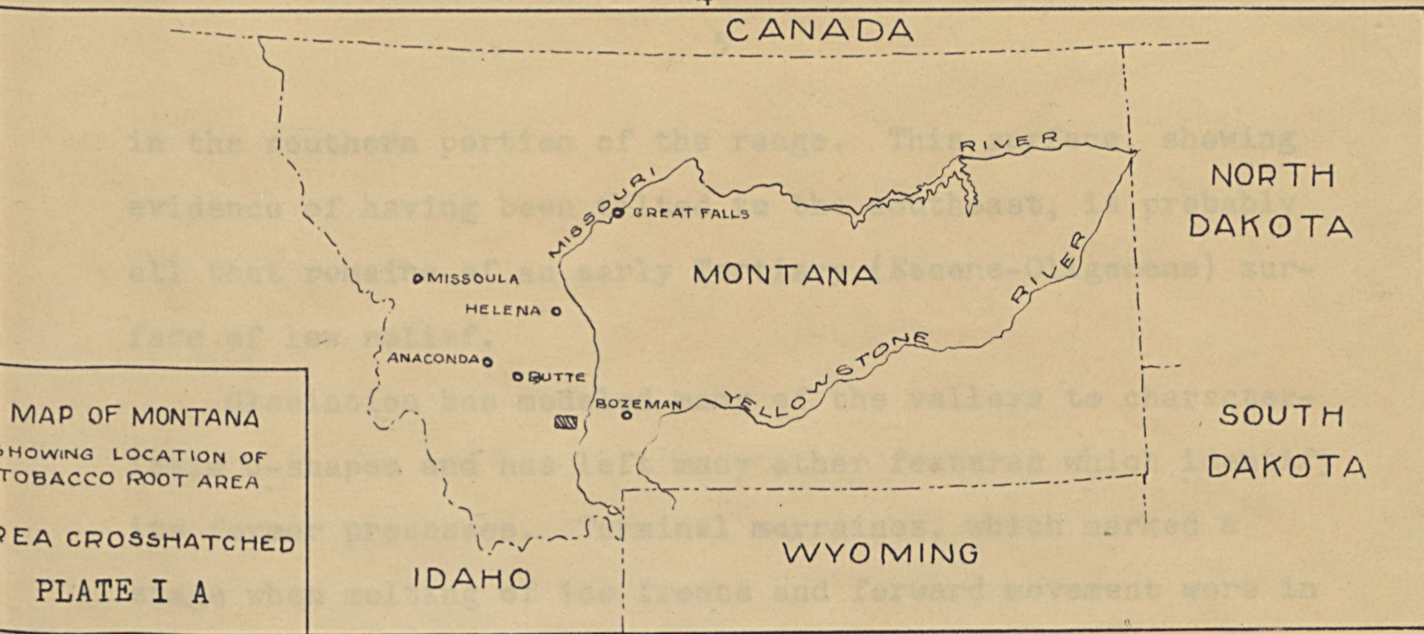
In January, 1953, Jean Clary and Lloyd Frizzel, both students at Montana School of Mines, made the initial tungsten discovery in epidote-garnet contact float from a contact metasomatic aureole north of the Strawberry group. Further prospecting showed the presence of scheelite in the Strawberry Mine, and later the Pony Tungsten Enterprises corporation was formed.

At the writing of this paper, a gravity mill has been installed, and production has just begun.

Physiography

Although the Tobacco Root Mountains generally exhibit moderate to high relief, the topography near the Strawberry Mine is more gentle. The main range itself has been likened by Tansley and Schafer to a block hinged on one side and thrust up on the other, producing a long gentle east slope and a steep westward-facing scarp. This effect is strikingly apparent in the northwestern front of the range which closely resembles the topography seen in the Basin and Range province of the southwestern United States. This rugged mountain region has been dissected by stream erosion and modified by glaciation.

Remnants of a gently rolling upland surface may be seen


CANADA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
IDAHO
MONTANA
MISSOURI RIVER
YELLOWSTONE RIVER
GREAT FALLS
MISSOULA
HELENA
ANACONDA
BUTTE
BOZEMAN
MAP OF MONTANA
SHOWING LOCATION OF
TOBACCO ROOT AREA
AREA CROSSHATCHED
PLATE I A

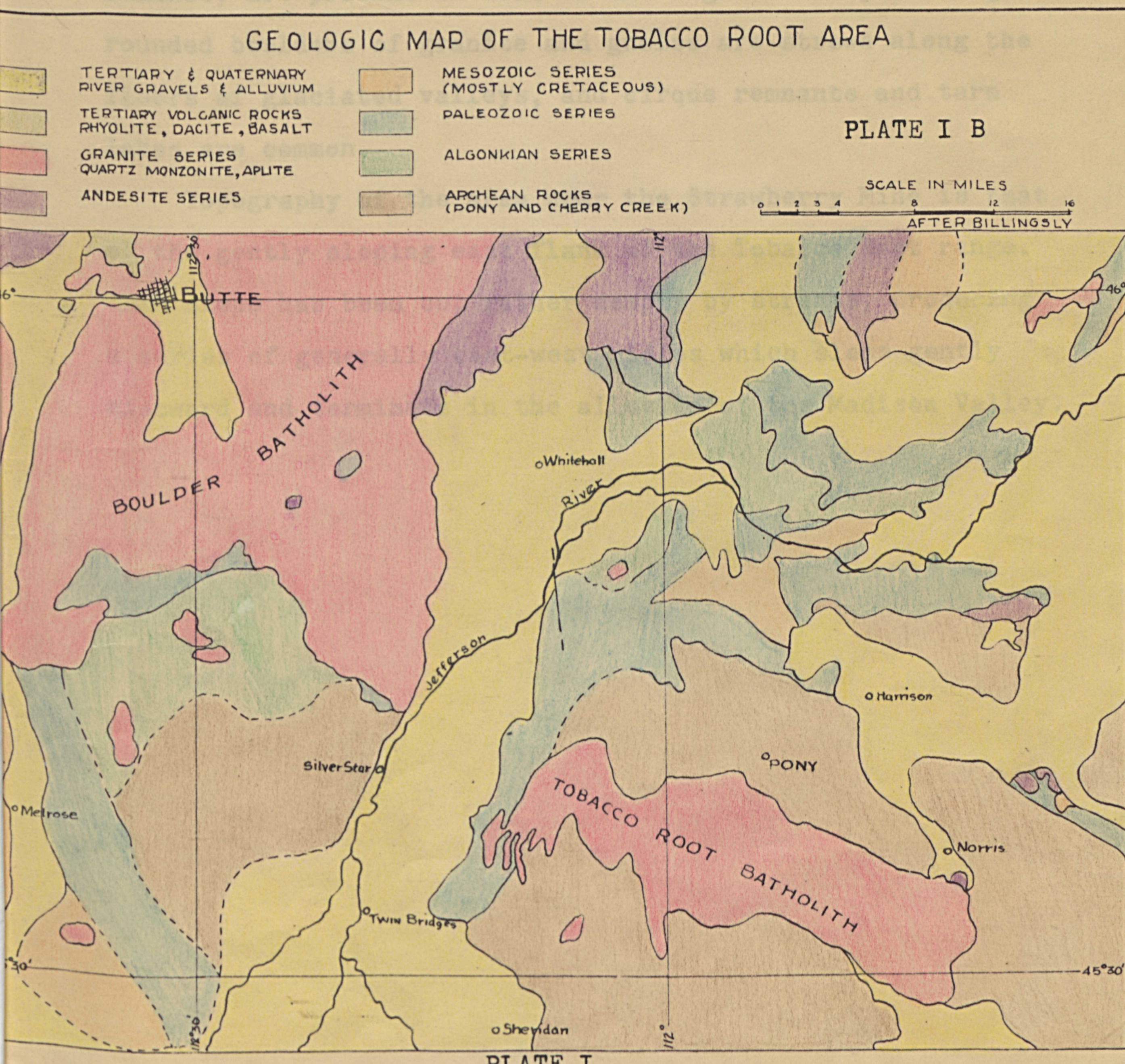

GEOLOGIC MAP OF THE TOBACCO ROOT AREA
TERTIARY & QUATERNARY
RIVER GRAVELS & ALLUVIUM
TERTIARY VOLCANIC ROCKS
RHYOLITE, DACITE, BASALT
GRANITE SERIES
QUARTZ MONZONITE, APLITE
ANDESITE SERIES
MESOZOIC SERIES
(MOSTLY CRETACEOUS)
PALEOZOIC SERIES
ALGONKIAN SERIES
ARCHEAN ROCKS
(PONY AND CHERRY CREEK)
PLATE I B
SCALE IN MILES
0 1 2 3 4 8 12 16
AFTER BILLINGSLY
BUTTE
46°
112°30'
112°
BOULDER BATHOLITH
Whitehall
Jefferson River
Harrison
PONY
Silver Star
Melrose
TOBACCO ROOT BATHOLITH
Norris
Twin Bridges
Sheridan
45°30'

PLATE I

in the southern portion of the range. This surface, showing evidence of having been tilted to the southeast, is probably all that remains of an early Tertiary (Eocene-Oligocene) surface of low relief.

Glaciation has modeled many of the valleys to characteristic U-shapes and has left many other features which identify its former processes. Terminal morraines, which marked a stage when melting of ice fronts and forward movement were in balance, are present in most of the higher valleys. Large rounded boulders of granite and gneiss are strewn along the floors of glaciated valleys, and cirque remnants and tarn lakes are common.

Topography of the area near the Strawberry Mine is that of the gently sloping east flank of the Tobacco Root range. This slope has been cut rather deeply by streams, producing a series of generally east-west ridges which slope gently eastward and terminate in the alluvium of the Madison Valley.

AREAL GEOLOGY

Two major rock types are exposed in the Strawberry Mine area. They are pre-Beltian (pre-Cambrian) metamorphic rocks of the Pony series and the intrusive quartz monzonite (granodiorite) of the Tobacco Root batholith. (Plate I, B) The Tobacco Root intrusive is considered by most geologists to be related to the larger nearby Boulder batholith of late Cretaceous or early Tertiary age. The Strawberry Mine lies entirely within rocks of the Pony series with the exception of a few tongues or dikes of quartz monzonite which extend from the contact about two miles south of the mine. However, the intrusive is apparently at a shallow depth below the Strawberry Mine due to a gentle northward dip of the contact, as suggested by exposures to the south. Several thousand feet north of the Strawberry Mine, an outlier or cupola-like mass of diorite a little less than a square mile in area is exposed.

An interfingering of the intrusive and metamorphics is very pronounced along the contact which has a general westerly trend. At the contact, many xenoliths of gneiss are included in the intrusive rocks. The xenoliths, of varying sizes and shapes, have retained their original foliation and are little changed with the exception of chilled borders in the form of finer grained zones which are present around some. No suggestion of alignment of the foliation in different xenoliths was noted. The great number of such inclusions near the contact suggests a stoping effect.

Metamorphic Rocks

The Pony Series: Where exposed in the Strawberry Mine area, rocks of the pre-Cambrian Pony series consist of gneisses of varying composition, as well as a few minor interbedded schists. Composition of the gneiss ranges from very dark amphibolites which are composed almost entirely of hornblende showing no foliation, to very dense hard biotite gneiss in which sparse biotite flakes are aligned in a groundmass of cryptocrystalline quartz.

As exposed above the East Keystone portal, large blocks of the amphibolite are arranged in the enclosing gneiss in a rude boudinage structure. Foliation planes of the gneiss are bent around the ends of the amphibolite blocks, whose long dimensions are parallel to the foliation. However, as in all other exposures, structure within the amphibolite is directionless. Two interpretations of this structure are possible; either the amphibolites represent basic dikes intruded into sediments of the pre-Cambrian Pony series and segmented by the movements which produced regional metamorphism, or they may have been intruded into the Pony series after metamorphism and segmented by still later movement.

The metamorphic rocks exhibit an areal strike averaging N 70° W, and range in their northerly dip from 50° to as great as 80°. Local isoclinal folding is present with small folds, probably drag folds, observed in an outcrop about 300 feet east of the lower level portal. The folds are very tight, usually symmetrical and show a great thickening at crests and troughs and thinning of flanks. Because no other small intense folds have been observed either to the east or west of this location, they probably represent a nearness to the axis of a major fold.

Augen structure is observed throughout the area, ranging in size from very small ¼ inch long dimensions to as large as

Figure 1

Augen structure from near the upper level portal. "Eye" is composed of microcline. ½ natural size.

two inch long dimensions. The "eyes" consist of feldspar, tentatively identified as microcline, with foliation planes of the gneiss diverging and bending around the feldspar (Figure 1). Their formation is attributed to late metasomatic processes.

The present composition of parts of the Pony series is attributed by Tansley and Schafer[1] to the regional metamorphism of pre-Cambrian intrusives. As examples, they cite gneisses of medium to coarsely crystalline hornblende, white quartz-feldspar gneiss having the appearance of metamorphosed pegmatite, and dark sills and dikes containing small lenses of feldspar oriented parallel to the prevailing schistose and gneissic structure. In the Strawberry Mine area, all rocks exposed having an amphibolite or amphibolite-schist composition are concordant with the gneissic structure. None show any indication of having been discordant at any time in their past history. Moreover, the presence of only minor quartz and feldspar suggests a possible derivation from original dolomitic shale. An amphibolite-schist, exposed in the footwall of the Strawberry structure on the lower level, is dominantly hornblende and biotite with minor quartz and feldspar. Accumulations of biotite have been aligned in a braided structure which parallels the prevailing gneissic foliation (Figure 2). Near these bands of biotite, the hornblende is rudely aligned,

1 Tansley, W., Schafer, P. A., and Hart, L. H., "A Geological Reconnaissance of the Tobacco Root Mountains, Madison County, Montana", M. B. M. G. Memoir No. 9, 1933.

but farther away this orientation is not observed. Later fractures are filled with calcite.

Figure 2

Hornblende-biotite schist from lower level, showing braided alignment of biotite in groundmass of hornblende and biotite. Fracture is filled with calcite. Plane polarized light, x 80.

A concordant amphibolite composed almost entirely of hornblende is exposed at the end of the upper level crosscut. The medium-grained green hornblende is entirely directionless.

Igneous Rocks

Quartz Monzonite: Tongues of igneous rocks from the nearby Tobacco Root batholith extend into the gneisses of the Strawberry Mine area. The largest of such tongues, most of which show a general north-south trend, outcrops just east of the lower level and is also exposed within the lower level itself. This rock is light gray and medium-grained. The borders of this mass contain many xenoliths of the surrounding

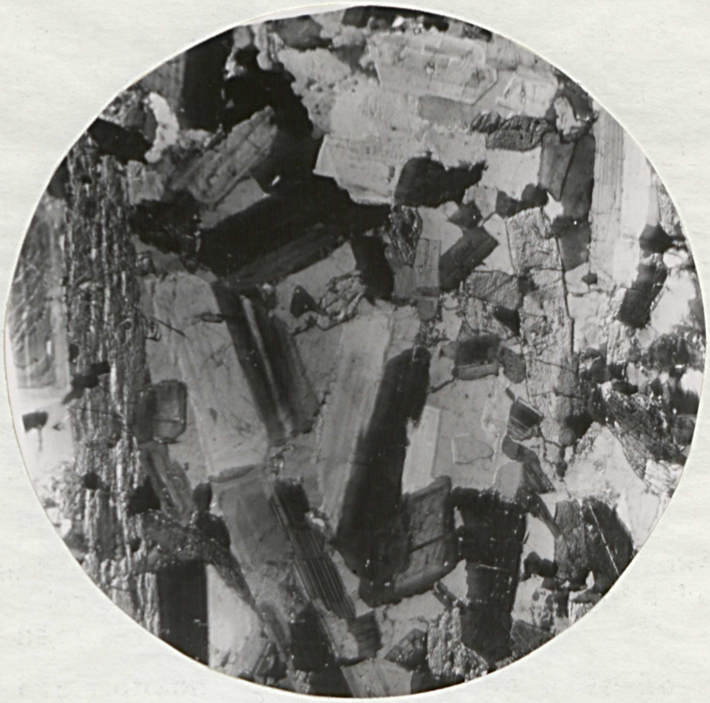


Figure 3

Quartz monzonite from outcrop near lower level portal. Note rough alignment of elongate hornblende. Crossed nicols, x 80.

gneiss, and much of the mass contains hornblende having a rude orientation megascopically. Microscopic study shows the rock to be hypautomorphic-granular with the composition of quartz monzonite. Andesine and orthoclase are nearly equal in amount, and much of the plagioclase shows distinct zoning.

Quartz makes up about fiver per cent of the rock, and light green hornblende is the dominant ferromagnesian mineral, with minor biotite. Microscopically, the orientation of hornblende is not as apparent as in hand specimens (See Figure 3). Accessory minerals include apatite, sphene (titanite) altering around the margins and along cleavages to leucoxene, pyrite, and a few scattered microscopic grains of scheelite.

About 200 feet within the lower level, a concordant intrusive rock approximately ten feet in width cuts across the

Figure 4

Quartz monzonite from lower level. White background, upper left, is quartz. Light gray backgrounds, center, right, and bottom is orthoclase. Included grains corroded by quartz and orthoclase. Crossed nicols, x 80.

workings. The composition is also that of quartz monzonite, medium-grained with the same composition as that just described. However, one half of the thin section examined shows very coarse grains of orthoclase and quartz with other mineral grains "floating" in them (Figure 4). A poikilitic texture is suggested, but many of the included grains cross boundaries between quartz and orthoclase. Moreover, many of the included plagioclase grains have been corroded by their host, whether it be quartz or orthoclase. This phenomenon will be discussed in another part of this paper. Accessory minerals in this rock include apatite, sphene, pyrite, calcite, and again a few scattered grains of scheelite.

Sphene (titanite) occurs in rather large euhedral to subhedral crystals and has been altered along the edges to leucoxene. Apatite occurs generally throughout the rock in euhedral to subhedral crystals, but the greatest apatite accumulations appear to be in clusters about the edges of, and growing into, pyrite grains. The evidence points to hydrothermal origin of apatite. Some cubic crystals of pyrite occur, and others may have been destroyed by partial plucking out of pyrite fragments in the preparation of the section. Calcite occurs interstitially as a replacement mineral along grain boundaries and in at least one place is bounded by orthoclase cleavage faces on one side.

Accumulations of hornblende have apparently been the most favorable loci for the introduction of pyrite and calcite, for the greatest number of pyrite grains are concentrated in these hornblende masses, and replacement by calcite has advanced to a greater degree. Partial alteration of the hornblende to clays has taken place where pyrite is most abundant, suggesting a greater circulation of hydrothermal solutions in these areas.

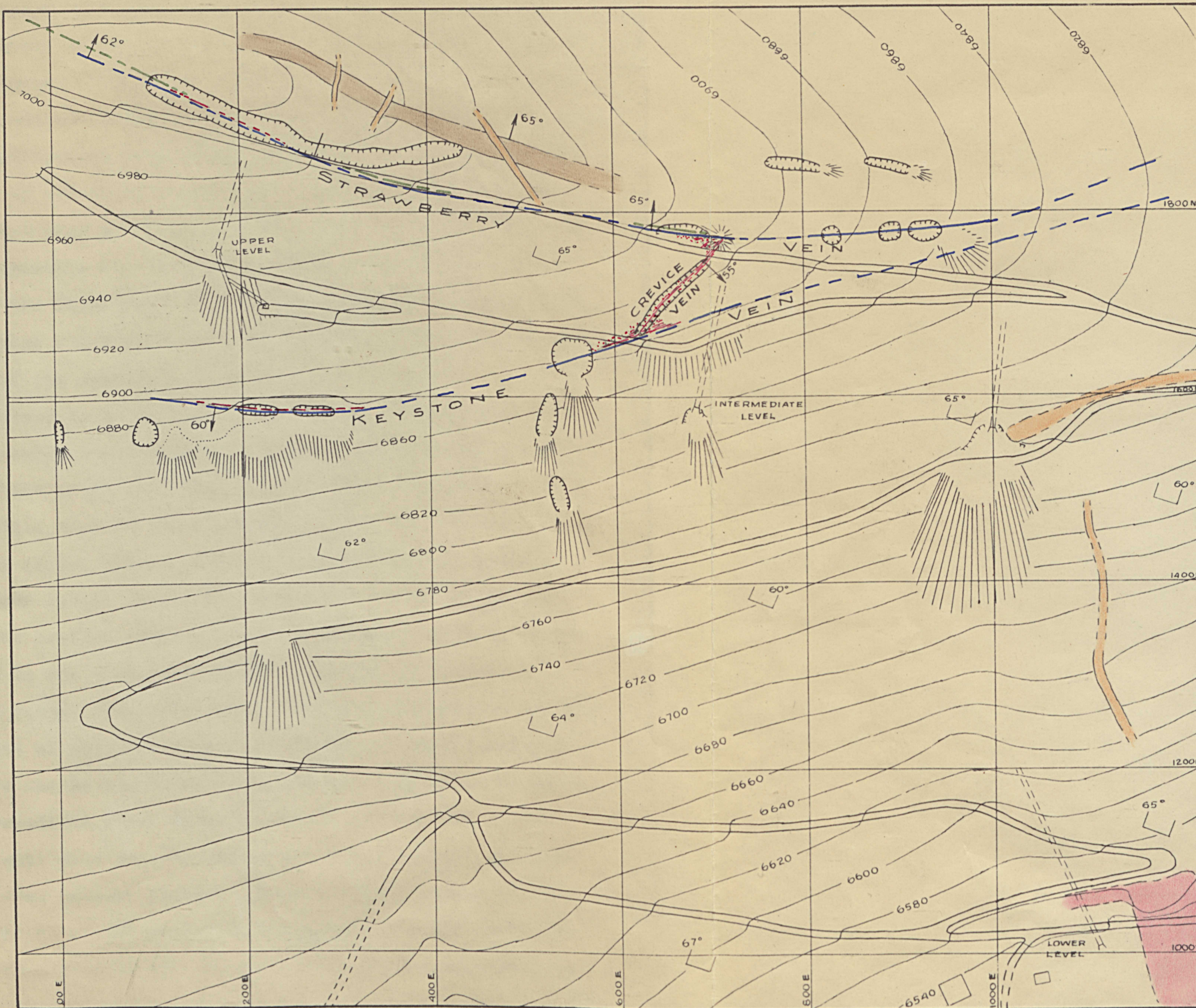
Pegmatites: Pegmatites, which represent late crystallization phases of the Tobacco Root intrusive, are widespread throughout the area. They range in composition from predominantly orthoclase or microcline with minor interstitial quartz, to almost entirely white "bull" quartz with very little feldspar.

Most of the pegmatites are dikelike, and crosscut the metamorphic rocks of the Pony series. They range in width from several inches to as great as 20 feet.

STRUCTURE

Structural features of the Strawberry Mine area appear to form a roughly conjugate fault system. Two major faults, the Strawberry and the Keystone, cut the area. (Plate II) Their strength is attested to by the reports of men who have thoroughly prospected the area, who claim to have traced the Strawberry fault for more than a mile to the east, and tell of prospects on both structures for long distances east and west. The northern of the two shears is the Strawberry with an average strike of N 70° W, dipping variably between 60° and 65° north. To the south, on an average strike of S 80° W, is the Keystone fault, dipping 60° south. As the strikes and dips imply, these faults are converging eastward and diverging in depth. At the upper level, the surface exposures of the two faults are approximately 200 feet apart (allowing for difference in elevation) and north of the intermediate level are about 40 feet apart. In this same areal position, where they are 40 feet apart at the surface, on the lower level the Strawberry fault is nearly 500 feet north of the Keystone. Due to the eastward slope of the Strawberry hill and the divergence of the faults in depth, the two do not intersect in the immediate area.

Between these two shear faults are a series of cross fractures, probably representing conjugate tensional fractures.



GEOLOGIC MAP
OF THE
STRAWBERRY MINE AREA
PONY, MONTANA

TRUE N
MAG N
21° 30'

SCALE

100 50 0 100
FT

CONTOUR INTERVAL 20 FEET

SCHEELITE MINERALIZATION

PYRITIC MINERALIZATION

FAULTS

DUMP

PIT

PEGMATITE

QUARTZ MONZONITE

HORNBLENDE GNEISS

PONY SERIES PRE-CAMBRIAN GNEISS & SCHIST

ROBERT L. MEYER

MAY, 1954

PLATE II

The strongest of these is the Crevice vein, which strikes N 45° E where stoped at the surface and which dips 55° to the southeast. From early reports and conversation with men who have stoped on the Crevice vein, it is apparent that there are no indications of movement on the vein; all confirm the evidence of its being a tensional opening. Nowhere in the present openings or in earlier reports on workings which are now inaccessible has the Crevice vein been found to extend north of the Strawberry fault or south of the Keystone fault. Other weaker cross fractures are present and may form further members of the system.

Moderate to heavy fault clays are associated with both the Strawberry and Keystone structures and may vary from 6 inches thick to several feet in very short distances. The hanging wall clay of the Strawberry fault has a distinctive blue-gray color, making it easily identifiable in surface cuts. Both faults range from very tight single shears to sheeted or braided shear zones as much as ten feet in width. Movement on the Strawberry fault is difficult to define, although rather hazy slickensides suggest both strike and dip components of movement with that of the dip being stronger. Much more can be concluded as to the Keystone fault movement. The intermediate level exposes massive slickenside in the hanging wall with well-developed mullion structure as large as 18 inches between crests. These mullions have a well-defined trend of 60° eastward, consequently a dip component greater than that of the strike. Steps on the slickensides and the general "feel" indicate that the hanging wall has gone down relative to the footwall.

Shears such as the Strawberry and Keystone are repeated along the northern margin of the Tobacco Root intrusive, all roughly paralleling the contact.

Tungsten Mineralization

Introduction

For several decades, tungsten mineralization has been known in the Tobacco Root area, being restricted, however, to the Potosi region, some 14 miles south of Pony within rocks of the Tobacco Root intrusive. Mineralization at that location consists of bladed aggregates of huebnerite ($MnWO_4$) in quartz veins. The tungsten occurs in irregular shoots and pods within the quartz veins, and attempts to mine it commercially have been intermittent and usually discouraging.

Until the past two years, the knowledge of tungsten mineralization was limited to the Potosi quartz-vein type. However, in 1952, extensive prospecting has revealed other areas and types of tungsten deposits, including contact metasomatic, and the Strawberry Mine type, which will be referred to as a replacement deposit.

Structural Relations

As shown by underground and surface maps (Plate II and Plate III), scheelite ($CaWO_4$) occurs in a "bed" or horizon adjacent to the hanging wall of the Strawberry vein. In all exposures to date, this spatial relationship holds true, and except for a possible minor dissemination beyond the limits of this horizon, the scheelite

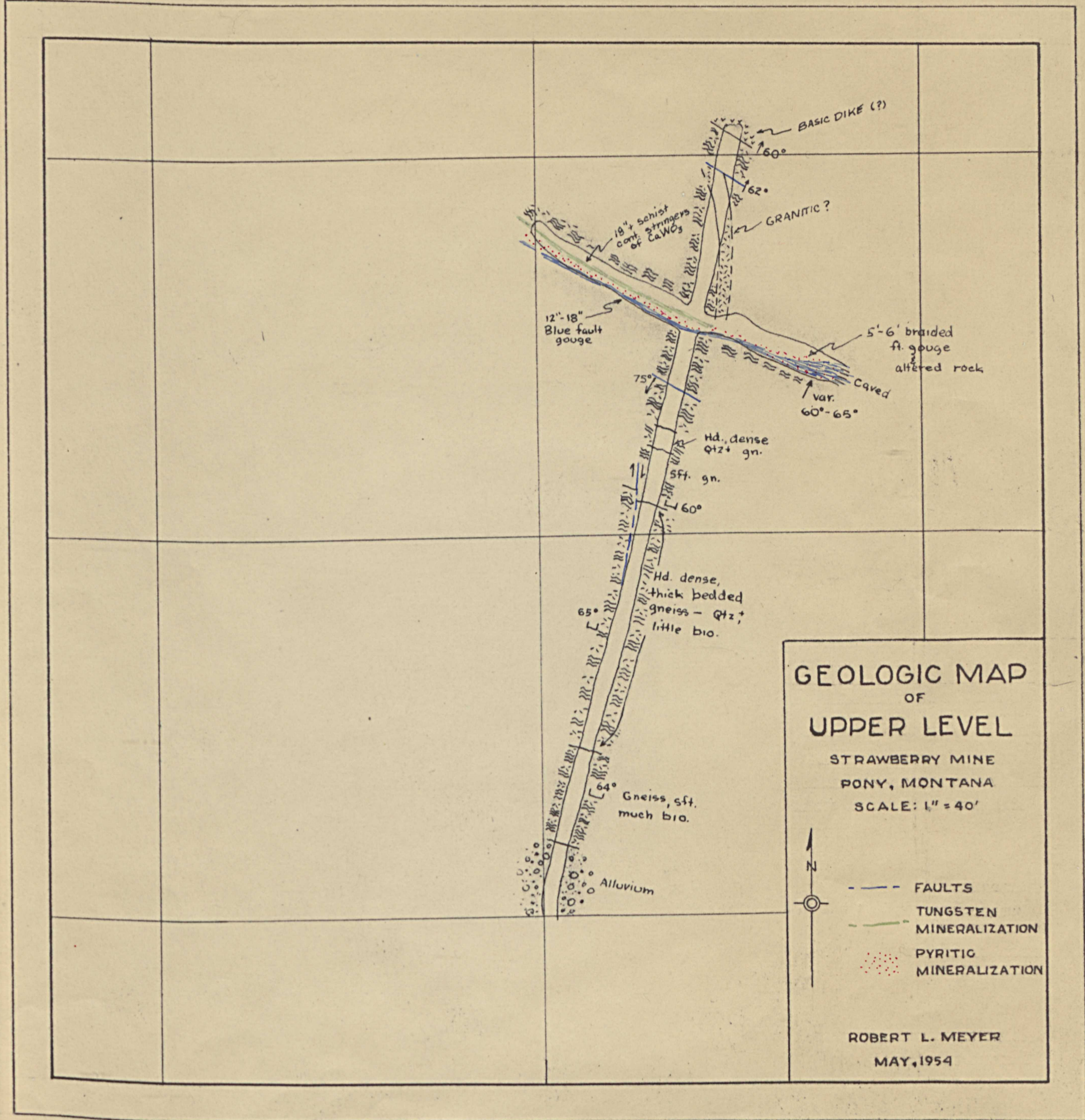

BASIC DIKE (?)
60°
62°
GRANITIC ?
18" ± schist cont. stringers of $CaWO_3$
12"-18" Blue fault gouge
5'-6' braided ft. gouge & altered rock
Caved
var. 60°-65°
75°
Hd., dense Qtz + gn.
Sft. gn.
60°
Hd. dense, thick bedded gneiss - Qtz + little bio.
65°
64°
Gneiss, sft. much bio.
Alluvium
GEOLOGIC MAP
OF
UPPER LEVEL
STRAWBERRY MINE
PONY, MONTANA
SCALE: 1" = 40'
N
FAULTS
TUNGSTEN MINERALIZATION
PYRITIC MINERALIZATION
ROBERT L. MEYER
MAY, 1954

PLATE III

is seemingly confined to the one horizon alone.

In the upper level, near the intersection of the crosscut and drift (Plate III), the horizon containing scheelite shows evidence of wedging out along the strike of the Strawberry fault structure. The same abrupt discontinuance of the scheelite, or the host horizon, is noted on the lower level nearly 500 feet east. On both levels, a slight divergence of the scheelite ore body and the Strawberry structure is evident as the two are followed westward. This divergence is on the order of several degrees and is accounted for by the slight difference in strike of the Strawberry fault and foliation planes of the host metamorphic rocks. Along the Strawberry fault, foliation planes of the gneiss have an average dip of around 60°N, but the dip of the fault itself averages nearly 5° greater, around 65°N. Such a difference in dips between the planes of the two, as well as the aforementioned slight divergence to the west, would cause the intersection of the two planes to be diagonally downward to the west. From present exposures, this seems to be the case. An exception is the presence, on the surface, of a scheelite orebody still in the same spatial relationship adjacent to the hangingwall of the Strawberry structure, from about 100 feet west of the upper level to the intersection of the Strawberry fault and the Crevice vein, nearly vertically above its exposure on the lower level. With local irregularities in strike and dip of both the Strawberry fault and the scheelite-carrying horizon, the intersection would necessarily be quite irregular in form, even to the extent of leaving lentil-like remnants of the orebody in the hangingwall side of the fault.

Ore Genesis

Several lines of investigation have proved tungsten mineralization at the Strawberry mine to be genetically related to the intrusion of the Tobacco Root batholith during late Cretaceous or early Tertiary time. The huebnerite-quartz deposits of the Potosi district are unquestionably related to this igneous activity, being located within the intruded quartz monzonite. North of the Strawberry deposit, tungsten occurs, by report, in a contact metasomatic aureole about a small stock or outlier of the Tobacco Root intrusive. Most pertinent evidence with respect to the Strawberry deposit is the presence of scheelite, as well as pyrite and calcite, in the igneous rock which outcrops near the lower level portal. In the quartz monzonite of this outcrop, scheelite is present as microscopic grains, very few in number, as well as pyrite and calcite.

The role of calcite is not clearly defined, but may be significant in scheelite deposition. It definitely is a replacing mineral in the igneous rock and is present as fracture fillings in a hornblende-biotite gneiss adjacent to the footwall of the Strawberry structure (Figure 2). With the few microscopic specimens studied, it would indeed be difficult to assign to the calcite any definite place in the paragenetic order. It is interesting to note, however, its hydrothermal association with relatively high temperature mineralization.

Scheelite of the orebody occurs as subhedral to anhedral grains which are aligned along prevailing foliation planes of the host layer. A specimen from the surface exposure of the Strawberry structure near the intersection of the Strawberry and Crevice veins shows the host rock to consist of alternate thick bands of feldspar with very little quartz, and thinner bands of hornblende and biotite.

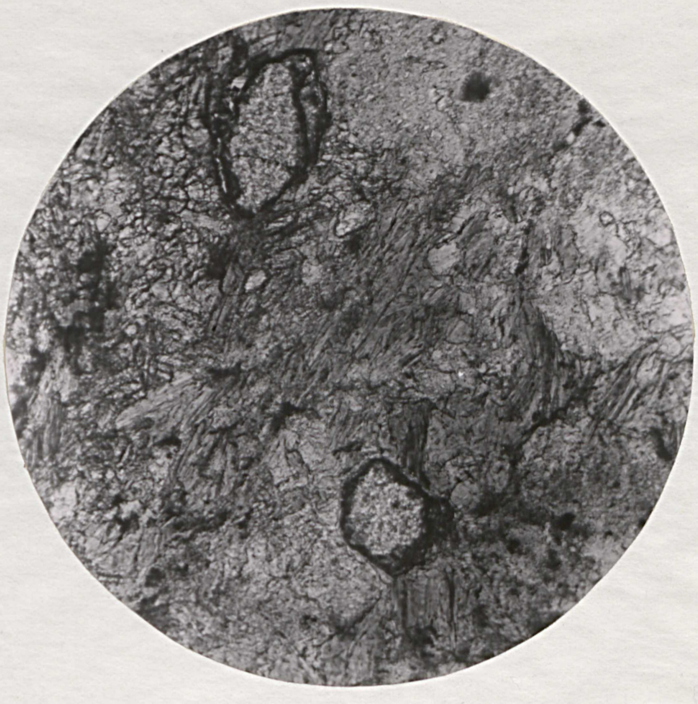


Figure 5

Ore from surface, showing grains of scheelite in groundmass of hornblende-biotite band. Plane polarized light, x 80.

Scheelite grains are confined to the hornblende-biotite bands and may be related to fractures which show small halos of alteration along their margins (Figure 5). Pyrite is scattered throughout the hornblende-biotite bands, and most show a hazy rim of iron oxide alteration. Some limonite pseudomorphs after pyrite are present.

A thin section of the ore from the lower level reveals a more massive scheelite concentration, but still aligned along the foliation. An interesting fracture pattern is present in the scheelite, consisting of parallel to sub-parallel shears with tensional breaks having the appearance of double barbs (Figure 6).

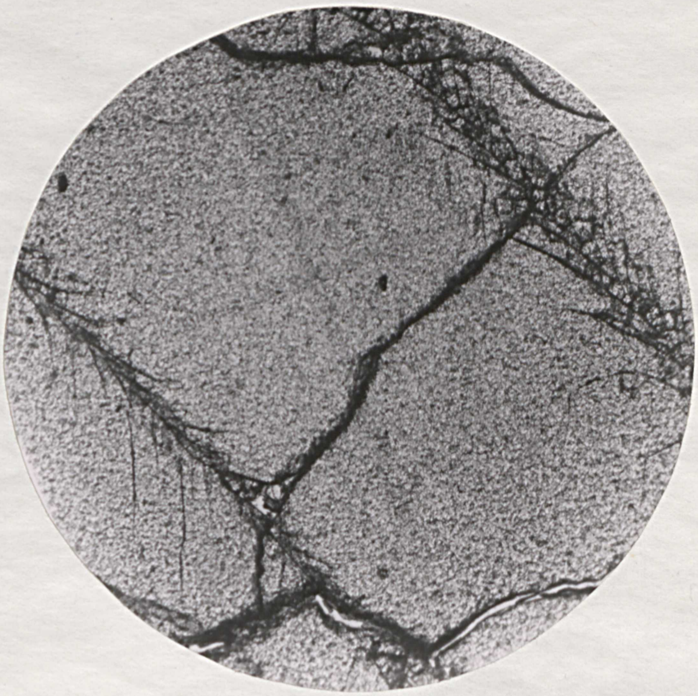


Figure 6

Scheelite from lower level, showing fracture pattern developed, consisting of shears with tensional barbs. Other fractures show rehealing by quartz. Plane polarized light, x 340.

A set of two such shears shows the related barbs pointing in opposite directions. The shears continue across the boundaries of grains having different orientations, and die out in hornblende-biotite.

Paragenesis

A study of polished and thin sections establishes a tentative proposal for paragenetic relations. Earliest of the introduced material may have been quartz and orthoclase. This is true of the margins of the igneous intrusive, where other rock-forming minerals have been corroded by later quartz and orthoclase, possibly of late deuteric origin (Figure 4).

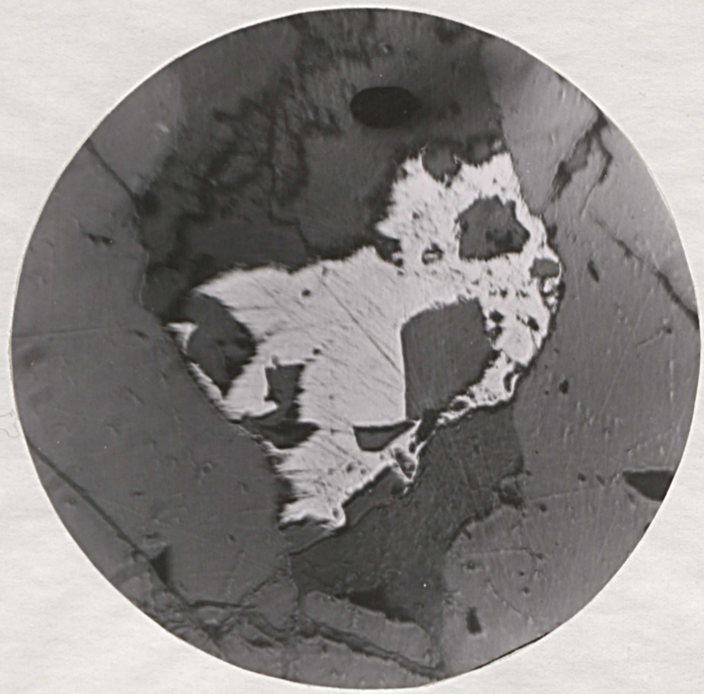


Figure 7

Polished section of ore from lower level.
Light gray is scheelite. Dark gray, quartz;
white, pyrite. x 320.

Scheelite was later than an early quartz mineralization, or may have been contemporaneous with its deposition. No decisive evidence was found to establish age relationships of the two. After the deposition of scheelite, possibly by replacement of hornblende,fracturing took place,the fractures being healed by a later stage of quartz.(Figure 7). Latest of all the minerals in the sequence was pyrite,which replaces the second-stage quartz,probably selectively in preference to scheelite.

Conclusions

Tungsten mineralization effected by hydrothermal solutions from the Tobacco Root intrusive has been extremely pervasive. This realization has been reached within the last two years by extensive prospecting in the Pony region. Scheelite and huebnerite occur in quartz veins,contact metasomatic deposits,and in replacement deposits.

At the Strawberry Mine,scheelite occurs as a replacement in a favorable horizon adjacent to the hanging-wall of the Strawberry fault structure. Tungsten and pyritic mineralization are genetically related,the scheelite being deposited prior to the pyrite. Both are unquestionably derived from the Tobacco Root intrusive of late Cretaceous to early Tertiary time.

Tongues of the intrusive extending from the contact into the Strawberry Mine area are of quartz monzonitic composition,and show corrosion by late quartz-orthoclase introduction. Small pegmatites are present,cutting gneisses of the pre-Cambrian Pony series,and ranging in composition from predominantly orthoclase with little interstitial quartz,to pegmatites predominantly "bull" quartz with very little orthoclase.

Present openings reveal a scheelite orebody which may be considered commercial,with close attention to mining techniques for a very narrow orebody. To bring the mine into production on a long-term basis,it is suggested that the orebody should be penetrated on the intermediate level,and preparation for mining and blocking our ore be made on this level. Until the time that such time and capitol is available, exploration to the east of present exposures should not be attempted. Higher priority should be given to the extension of the orebody westward,where the necessity of solving structural problems is less likely, and where a greater vertical range is possible.

Acknowledgments

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